Light and Lighting

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"Tolerance"

SIR Charles Darwin's delightful address to the I.E.S. (p. 86) illustrated, in a very interesting manner, the part played by tolerances in physical measurements.

His examples were drawn from fields outside illuminating engineering, but this did not in any way detract from the interest. I.E.S. members enjoyed being taken off the beaten track.

There can be no question, however, of the direct bearing of tolerances in illuminating engineering. All measurements of light are based ultimately on the impressions of the human eye, that wonderful and yet limited organ. All photometric data need to be interpreted, even to be taken with a grain of salt, but are none the less valuable on that account.

In another sense, with which Sir Charles made play in his open remarks, tolerance is vital to illuminating engineers who include in their ranks so many different types of experts whose sometimes divergent views must be weighed with tolerance.

There remains the consumer, the man who pays. Often he has something pertinent to urge, sometimes he has merely a bee in his bonnet; but in any case he must be tolerated and heard with sympathy and understanding.

35 Years of Illuminating Engineering

During the present session the I.E.S. Birmingham Centre has been favoured by visits both from the president (Dr. H. Buckley) and the hon. secretary (Mr. J. S. Dow). The former recently repeated his presidential address, and at the annual meeting of the Centre on June 2 Mr. Dow gave a short talk reviewing experience with the Society since its inception 35 years ago. In the course of the meeting Mr. C. J. Alderidge gave a very full account of the activities of the Centre during the session and alluded to forthcoming events. Amongst these, special interest attaches to a forthcoming civic conference in Birmingham, when an opportunity will be afforded for I.E.S. representatives to present the case for lighting in connection with post-war reconstruction measures. At the request of the chairman (Mr. A. J. Pashler) Councillor Potts, himself an I.E.S. member, gave some account of the proposed arrangements, in which he was taking a leading part. Mr. Dow, in his survey of events since 1909, recalled the conditions at that time, when there were very few experts on lighting. Mr. Gaster, the founder of the Society, had therefore aimed at enlisting the help of other specialists, such as architects and physiologists, and promoting co-operation between producers and users of light. Illuminating engineering involved the study of results as well as the means by which they were obtained, and the human element therefore played an important part. After referring to various milestones, such as the death of Mr. Gaster in 1928, and the holding of the International Illumination Congress in this country in 1931, Mr. Dow contrasted experience during the last Great War with that during the present one, commenting on the great recent growth in membership, the formation of new Centres and groups, the establishment of Fellowship, and the prestige gained by the I.E.S. through its public work on war-time street lighting and in other directions. The success of Centres and Groups had been the result of much hard and enthusiastic work, for which those on the spot, quite rightly, received the main credit. At headquarters the value of such local organisations had always been realised—indeed, even before any Centres existed, and he recalled meetings for this purpose held in Manchester, Liverpool, and Birmingham in 1932, which he and others from London had attended and addressed. In conclusion, Mr. Dow laid stress on the reputation for disinterested public service, which had greatly aided the Society's efforts to promote appreciation of better lighting, and which it should be zealous to maintain whatever new developments might come about in the future.

New I.E.S. Group in Stockton-on-Tees

First General Meeting

The first general meeting of the newly-created I.E.S. Group in Stockton-on-Tees took place on April 16, when Mr. Lay, the honorary secretary of the Newcastle Centre (within whose sphere the new Group is located) read his paper on "Lighting for Production." This was on similar lines to the paper previously read by Mr. Lay in Newcastle.* On this occasion the lecturer paid special attention to contrast in brightness and conditions of shadow—factors which do not always receive sufficient attention in design—and he quoted instances in which quite slight adjustments in the position of fittings influenced the effectiveness of the lighting considerably. The paper lead to a good discussion. Quite a number of interesting points were raised. Mr. Ellerker quoted the case of a Ministry of Food Office which was subjected to an inquiry because certain lights were left burning, though people were working in the area at the time. [It appears that the allowance of 1¼ watts per sq. ft. sanctioned for shops and restaurants, etc., does not necessarily apply to offices!] Mr. Field mentioned a school which was trying to get teachers who, however (good for them!), refused to work unless they were furnished with class-rooms which were properly lighted. Scholars, as well as teachers, were affected, however, the number of absentees being definitely fewer in those class-rooms which were well lighted. Mr. Lay himself confirmed that the lighting in some elementary schools is still exceedingly bad. He had recently been lecturing to a Home Guard unit in a class-room so poorly lighted that the demonstrations, though of quite a simple character, could not be seen. Other problems put to Mr. Lay included the measurement of brightness, the illumination of vertical surfaces and the phenomenon of "contrast induction"—all queries with which he dealt faithfully in the time at his disposal. One is glad to see that this Group is already in active operation. At a previous meeting a working committee had already been elected with Mr. W. E. Dalby as chairman, Mr. R. H. Batey as honorary secretary, and Mr. R. J. Patrick as honorary treasurer.

* See "Lighting and Lights," July, 1942, p. 88; August., 1942, p. 100.

Illuminating Engineering Students

Whilst some doubt may naturally be felt as to the situation which the Lighting Industry will face immediately after the war, it seems at least highly probable that for some time to come there will be an exceptional demand for the services of lighting engineers. There is much leeway to be made up in connection with the lighting of buildings, as there will be a great deal of restoration work to be done. New developments have been few, apart from those in the national service during the war period. There should, therefore, be opportunities for illuminating engineers. In present circumstances there are, naturally, very few students in this field in this country. It is rather curious, however, to learn from *Illuminating Engineering* that even in the United States there are signs of a definite shortage of students taking courses in illumination. A survey of a hundred colleges and universities shows a preference on the part of students to take courses in communication rather than in illumination. Out of more than fifty per cent. returns to questions only three colleges stated that they are now giving courses in the principles of illuminating engineering, and in each case to skeleton classes. It looks, therefore, as though, even in the United States, there may be a shortage of young illuminating engineers and a lack of trained men in the future.

Tolerances and Their Effect on Physical Measurements

(Summary of an Address delivered by Sir Charles Darwin, Director of the National Physical Laboratory, to the Illuminating Engineering Society on May 9th, 1944.)

The tolerances that may be admitted in manufacturing processes have always been an important matter in works practice, but they have tended in the past not to be considered as a subject for deep study, but rather as a nuisance that would not arise in a perfect world. The physicist, because he was always formulating exact laws and then trying to verify them experimentally, regarded tolerances in a similar manner, and teachers were still worse—in fact, it might be said that, in this respect, teaching has tended to be almost entirely "intolerant."

Recent developments in theoretical physics have, however, very much altered this view, and have shown that the subject of errors and tolerances is not only interesting in itself but is important in the foundation of physics.

A series of examples was given showing some interesting points in considering tolerances. A simple case is presented by an audience at a lecture, which may be stated approximately but is subject to variation because some will possibly arrive late and others may leave early to catch a train. The number of people killed in motoring accidents used to be at the rate of about 500 a month. The law of chance indicates that the probable fluctuation in this number is equivalent to its square root, i.e., about 23.

A particularly interesting case which the lecturer analysed was a machine for weighting bullets. The speed of the operation depended on the permissible tolerance, but in practice it was proved that in any case one could not weigh the bullets faster than about one a second. Another good instance is to be found in the recognition of the correctness of the pitch of a musical note by means of beats. It was shown that a man singing the C below middle C could sing for 1-6th of a second before a departure of one semi-tone could be detected—whereas a soprano singing the upper C with four times the frequency, would give herself away in 1-24th of a second.

Turning next to optics, the lecturer explored the idea of "resolving power" as worked out by Lord Rayleigh about 70 years ago, showing that in this case the toleranace was fixed by the wave-length of light. This applies to the ordinary microscope, but in the case of the electron microscope the limit depends on the voltage of the electrons; at 60,000 v. it is about 10^{-8} cm—though it was explained that owing to other problems of design it is impossible to see single atoms, as this figure might suggest. In the case of X-rays we come down to about 10^{-9} cm, and in the case of the gamma rays to 10^{-13} cm. Consideration of such apparatus led to a reference to the Quantum theory, the ideas of the American Compton and the contradictions between the older theories and the quantum theory, finally explained by Heisenberg in 1926. The essence of the conclusion propounded by the lecturer was that whilst the electron may have a definite position and a definite velocity one can never find them both with precision at the same time—an idea embraced by the "Uncertainty Principle," which is perhaps only one of a number of limitations to tolerances in nature.

The lecturer concluded by taking an example from pure mathematics, namely "irrational" numbers, such as the square root of 2. Whilst it is strictly true that there is no such number, one can nevertheless give it a certain definite value to so many places in decimals, provided a definite tolerance is also agreed.

Reviews of Books

The Application of Radiant Heat to Metal Finishing, by J. H. Nelson and H. Silman. (Chapman and Hall, London, 1944; pp. 79; figs. 37. Price 8s. 6d. net.)

This work is described as a critical survey of the infra-red process for the stoving of paints and enamels. The development of this process is largely due to the war situation, speed being a dominant consideration. It is, however, likely to influence future practice profoundly, and this concise study of its possibilities is therefore timely. The first chapter is an introductory and contains a table comparing drying times for various materials by convection and radiation. The second chapter discusses principles of heat transfer and contains some useful graphs and diagrams drawn from various sources. The chapter is concluded by several important inferences, emphasising the desirability of maximum temperature difference between source and object treated, and explaining the efficiency of radiation on the basis that quantity of heat transferred by this process depends on the *fourth* power of the temperature difference. Chapter III. traces briefly the history of the infra-red process, from the work of Groven onwards, and discusses electric bulbs as sources of heat, whilst Chapter IV. deals with reflectors, materials, and design, and Chapter V. with plant construction. The final chapter deals with applications under three heads: (a) low energy and closed ovens, (b) any energy density and open units, and (c) high energy density and enclosed ovens. This is aided by several effective illustrations, notably a picture of an American plant engaged on the drying of a tank.

How Good Lighting Aids Production Efficiency. (Memorandum prepared by the E.L.M.A. Lighting Service Bureau, London, 1944. pp. 19.)

This concise memorandum puts the case for good industrial lighting clearly and well. The evidence in support is assembled in a series of ten appendices. A table is presented showing the increase in production in various industries resulting from higher illuminations. Quotations from reports of the Chief Inspector of Factories indicate the influence of improved lighting in reducing accidents, and there are other important factors, such as reduction of spoilage and better use of available space and tools. An interesting point is that older people need more light than do those who are relatively young.

SITUATION VACANT

The Council of the Illuminating Engineering Society will shortly be considering the appointment of a Secretary. Applicants should give particulars of age, qualifications and experience (secretarial and otherwise), salary desired, and approximate date when services would be available. Knowledge of Illuminating Engineering is desirable. Applications should be sent to the Honorary Secretary of the Illuminating Engineering Society, 32, Victoria-street, London, S.W.1.

LIGHTING UNDER POST-WAR CONDITIONS

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The "Standards Review"

An interesting event has been the appearance of the first issue of a new publication — the *Standards Review*, issued quarterly, which is devoted to the work of the British Standards Institution. A foreword by Sir Percy Ashley, chairman of the General Council of the B.S.I., outlines the aims of the new publication, which should give greater publicity to the work of the Institution but will also contain information on developments in other countries. This first issue is eminently readable. It contains notes on such varied topics as standardisation applied to housing, temperature measurements, future electrical standardisation, a scientific garment sizing system, and basic English! It alludes to the work of the United Nations Standards Co-ordinating Committee and to standardisation overseas. Finally, it is liberally illustrated and—unusual in these days—is printed in type of reasonably large size on excellent paper.

Electrical Association for Women

19th Annual Report

The 19th report of the E.A.W., presented at its annual meeting on May 18, is illustrative of the change in the national mood from "grim determination" to "optimistic determination" and of the general tendency—however busy people may be with their present tasks—to see visions and dream dreams. Its post-war reconstruction report has been received with general interest, and its programme of lectures during the past year has been very considerable. The Association has now an imposing list of branches, to which additions have recently been made, grouped under a series of areas on lines similar to those adopted by the I.E.S. We note that the president is still the Dowager Lady Swaythling and the director and secretary (of course) Miss Caroline Haslett, well known to I.E.S. members.

Retirement of Mr. P. J. Robinson

By the retirement of Mr. P. J. Robinson, City Electrical and Lighting Engineer of Liverpool, public lighting has this year lost one of its most energetic and enthusiastic servants. In making a presentation to him and Mrs. Robinson, Mr. E. J. Morland recently bore witness to his sportsmanship and lovable disposition, and Alderman A. Critchley, chairman of the Electric Power and Lighting Committee, referred in appreciatory terms to his long period of service, extending over 42 years.

Town and Country Planning Association

The above photograph was taken on May 25th, 1944, in the new industrial lighting demonstration room at the E.L.M.A. Lighting Service Bureau on the occasion of a meeting of the Town and Country Planning Association, which was addressed by Mr. E. E. Hoadley on "Electricity after the War."

The photograph shows, from left to right, Mr. V. W. Dale (Asst. Director and Secretary, British Electrical Development Association), Mr. W. J. Jones (Director, Electric Lamp Manufacturers' Association), Mr. E. E. Hoadley (Consulting and Resident Engineer and Manager, Maidstone Corporation Electric Supply), Mr. C. G. Seeley (Member of E.L.M.A. Council), and Mr. F. J. Osborn (Secretary, Town and Country Planning Association).

I.E.S. Lighting Reconstruction Pamphlets

No. 1. Principles of Good Lighting.
No. 2. The Lighting of Public Buildings.
No. 3. The Lighting of Schools.
No. 4. Natural Lighting.

All may be obtained on application to The Illuminating Engineering Society, 32, Victoria-street, London, S.W.1.

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Others in preparation.

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Research in Problems of Vision

(Summary of a lecture delivered by Dr. W. S. Stiles to the Physical Society, on May 24th, 1944.)

Dr. W. S. Stiles gave a very interesting lecture on "Current Problems in Visual Research" at a recent meeting of the Physical Society held on May 24, the President of the Society, Prof. E. N. da C. Andrade being in the chair. A large number of members and visitors were present, and after the lecture there was an interesting discussion in which a number of well-known workers in this field of research participated.

When the sensitivity of the retina was being investigated, said Dr. Stiles, it was usual to give the subject some simple task to perform, or judgment to make, and on this basis to determine a threshold at which there was a 50 per cent. chance of his being able to carry out the given task correctly. The lecturer then went on to say that the eye was so sensitive when thoroughly adapted that the number of quanta of energy needed to excite a threshold sensation was quite small, perhaps of the order of 10. It followed that there must necessarily be a random fluctuation in the physical stimulus and this might well be the cause of the random differences in the observed values of the threshold, differences which had hitherto been ascribed solely to physiological causes. Lt. Pirenne had suggested this effect as an explanation of the lower threshold for binocular as compared with monocular vision. The threshold varied over the visual field, and some slides were shown to exhibit the effect of deprivation of Vitamin A in reducing the area of the retina at which the threshold had a given value, as shown by ability to detect a small test-object of given luminous intensity (Air Commodore P. C. Livingston's test).

Dr. Stiles then went on to discuss the functions of the rods and cones in vision, and showed how the sensitivity curve for the cones gave place to that for the rods as the illumination of the retina was reduced. The visibility curve was, he said, very dependent on the conditions of observation, particularly the area of the retina which was operating, and recent work by Wright and Walters had taken this into account.

The next section of the lecture was concerned with the retina when subjected to changing conditions of illumination, e.g., its recovery after being subjected to a bright flash of light. The work of B. Crawford and of P. Schouten on this subject was described.

Finally Dr. Stiles dealt with phenomena of colour vision. He showed how the observed facts of colour mixture and the various types of colour blindness could be explained by assuming three types of cone mechanism, but he pointed out that so far it had not been possible to isolate three chemicals analogous to visual purple. A threshold of importance in colour vision was the "hue limen" or sensitivity to a very small difference of colour. Attempts had been made to obtain a form of colour chart on which the limen would be represented by a constant distance for every colour, i.e., at every part of the chart. The most recent of these attempts was the non-linear transformation of the ordinary chart, proposed by P. Moon and D. E. Spencer.

In the discussion, Dr. W. D. Wright said he felt that if one studied Hartline's work, one would be led to the conclusion that the variations in sensation were much more likely to be physiological in origin than due to variations in the physical stimulus. Dr. K. J. W. Craik said that long-period variations could not be due to quantum fluctuations, while Lt. Pirenne pointed out that while rhythmic variations were likely to be due to physiological causes, purely random fluctuations might well have a physical origin.

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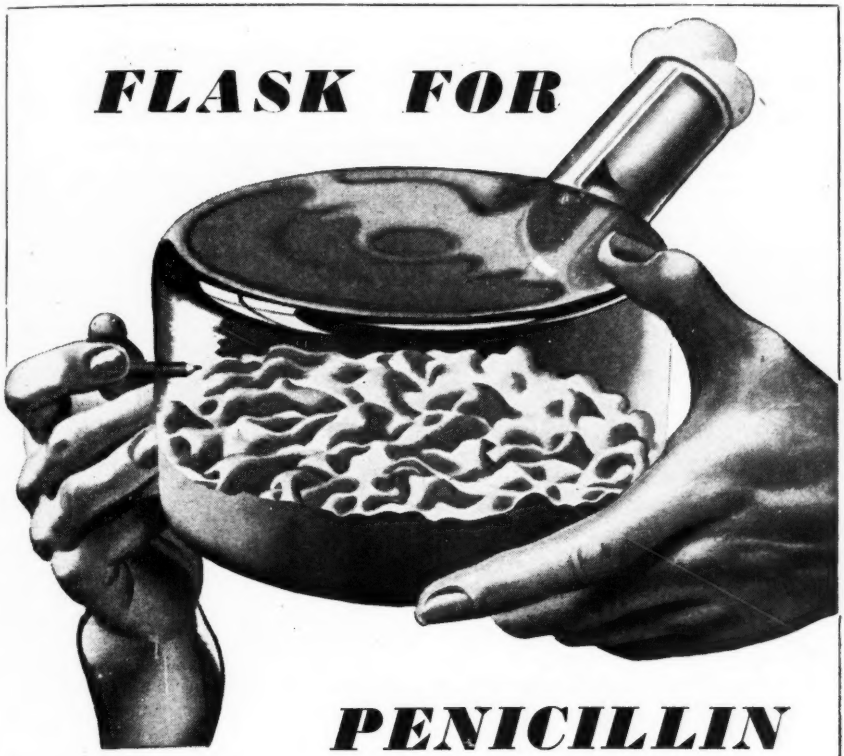

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Fluorescent Lighting in a Large Rolling Mill

An interesting example of virtually shadowless lighting has recently been carried out in a large rolling mill, which is permanently blacked out and operates day and night, almost continuously. The original installation consisted of 1,000-watt Gasfilled Lamps in dispersive type reflectors suspended at Truss level 26 ft. 6 in. These have now been superseded by "Sieray" 80-watt Fluorescent Tubes in Reflector Fittings.

The aim was to instal the new Fluorescent Lighting without any substantial alteration to the cable runs, which would have caused considerable expense and inconvenience. Further, as there are three Traveller Cranes extensively used on all shifts, new installation work would have seriously interfered with production. It was, therefore, decided to instal the 80-watt Fluorescent Tubes in suitable reflector fittings mounted in rows of ten fittings on alternate roof trusses along the whole length of the sheet mill. The existing cable system was extended to service the additional lighting points without the necessity for work in the roof, this extension being carried out from the travelling cranes.

A total of 250 tubes were installed in this section of the mills, representing a saving of 9.5 kw. As will be seen from the photograph the effect is not dissimilar to that produced by good natural roof lighting, with the additional advantage that it is not subject to change with the time of day or night. The way in which even the insides of rolls of sheet metal are illuminated is very striking. The illumination averages six foot candles throughout.

Accessibility in maintenance offered some difficulty; it was therefore decided that every tube point should be connected through a socket and plug. It is now possible to isolate from a crane any particular tube quickly, until such time as a crane may be available to rectify any trouble or for replacement.

The lighting layout was carried out by the Mill's Engineering Department in conjunction with the Lighting Service Department of Siemens Electric Lamps and Supplies, Ltd., 38/39, Upper Thames Street, London, E.C.4. The installation work was carried out by the Contractors, Messrs. Rashleigh Phipps and Co., Ltd., Electrical Engineers, 2, Hanover Square, London, W.1.

View of a section of a large Rolling Mill in which fluorescent lighting has recently been installed. An illumination of 6 foot-candles is provided and a saving in consumption of 9.5 kw. has been effected. The soft nature of the lighting, which permits a clear view from end to end, is evident.

Future Developments in Lighting Technique

An interesting talk on this subject was given to the I.E.S. Derby Group on May 2 by Mr. T. S. Jones. After reviewing the trend of lighting development in the past, from the days of the camp-fire onwards, Mr. Jones drew attention to the somewhat abrupt turn given to technique by the arrival of the 5-ft. fluorescent tube. He recalled that up till now, when reliance was placed mainly on filament lamps, the tendency had been towards progressively greater brightness and efficiency, so that the direction and screening of the light by means of reflectors, louvres, etc., was a point of fundamental importance.

The qualities of the fluorescent lamp —low brightness, extensive luminous area, daylight colour and high efficiency —are likely to influence profoundly technique of the future, when such lamps will doubtless be available in much greater profusion and variety.

The first reaction to their introduction was unqualified admiration. It was perhaps too rashly assumed that sources of such low brightness could be placed anywhere without causing discomfort; it was overlooked that even sources of quite low brightness may prove troublesome if the contrast with their background is too great. In the United States the use of completely unscreened lamps persisted but a short time. Exposed and inverted troughs with open ends were originally next used, but subsequently ends were closed and louvres were inserted at intervals to prevent direct vision of the tube from the usual angles. Reviewing usual practice Mr. Jones remarked that in fairly small rooms a few tubes suspended at various distances from flat ceilings, and held in position by the merest skeleton having virtually no reflection surface of its own, might be permissible, especially where plenty of light on the walls is desirable to illuminate maps, charts, shelves, etc. But in the case of large areas such conditions are rarely satisfactory. Long lines of light, perspectively converging, may or may not enhance an architectural motif, but in themselves they are apt to prove distracting, and the contrast between the light source and its immediate background is often still too high.

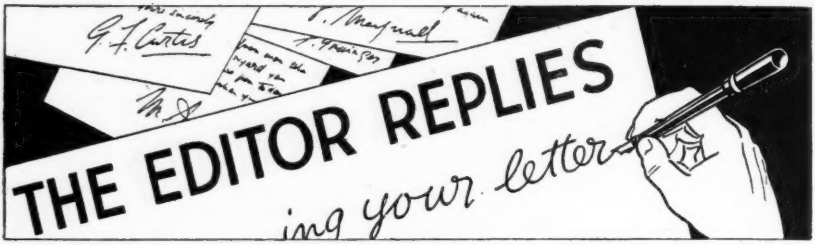
These are other points which deserve attention, especially as illuminating engineers are tending to become more concerned with degrees of brightness and contrast, rather than mere lumens per square foot. Large area sources have, however, come to stay.

Looking to the future the lecturer suggested that in this country manufacturers might prove to be somewhat less prodigal in their range of types than those in America. Built-in and architectural lighting should have a great impetus. In such work the co-operation of the architect is essential. Mr. Jones illustrated the effect of architectural structure by discussing the results from different forms of cornices, housing tubes, not all equally efficient or convenient.

Discussing the future of plastic materials the author remarked on their relative lightness and the ease with which they can be worked as evident advantages. Against these merits must be considered such possible drawbacks as tendency to become warped, brittle or scratched, or—and possibly—a tendency to collect static electrical charges.

There was also the convenient possibility of introducing fluorescent materials into certain plastics and using large luminous areas excited by u.v. radiation.

In conclusion the lecturer indicated that the future technique of illuminating engineering would be more concerned with (a) colour background and distribution of illumination to produce visual comfort, (b) calculations involving linear sources and indirect illumination from architectural features in vertical or horizontal planes, (c) colour, and the effect of coloured light on pigments, (d) the computation of requisite illumination by consideration of such factors as those suggested by Mr. H. C. Weston, (e) accurate calculations of lighting values obtained from primary or secondary sources of large surface area.



A rather curious point, which, evidently, is of fundamental importance in relation to illumination, was brought to my notice recently. What is the **exact explanation** of the **improvement in perception** by the eye with **increased illumination?** The work of Lythgoe and others has shown beyond doubt that, up to quite a high value, higher illuminations do enable us to see better, but I am not sure that even physiologists can tell us exactly *why* this is so.

One relevant circumstance is that higher brightness causes the **pupil aperture to contract,** which has the same effect as stopping down a camera lens. (Curiously enough, the beneficial effect of this contraction was not realised in early propaganda for good lighting, the argument being that it diminished the amount of light entering the eye, and that the ideal was a wide-open aperture, admitting a maximum of light.)

This, however, is probably only a secondary effect, operating mainly at relatively low illuminations and depending greatly on the presence or absence of optical defects in the eye-lens. It seems more likely that **the main effect is retinal,** though it may be doubted whether we yet understand precisely what happens to ensure the improvement in vision.

Is **local lighting** sometimes **a necessity?** Some lighting experts claim that this is so—because only by this means can one secure economically the very high illumination necessary for certain processes. In addition there is a well-understood preference, especially on the part of older workers, for a light under their personal control.

Other engineers with wide experience of industrial lighting do, however, contend that if the system of general lighting is *really good* workers will readily accept it and forget their fancy for local lamps. I notice that Mr. S. D. Lay, in his recent address to the I.E.S. Stockton-on-Tees Group, gave it as his experience that workers accustomed to local lighting would not be readily satisfied with general illumination of, say, 15 foot-candles. There is, of course, another point in favour of local lighting—that it facilitates the ideal of making the actual working material **the brightest object in the field of view**—a condition not so easily attained with general lighting when the working material (e.g., black cloth) has a very much lower reflection factor than the surroundings.

How far can the so-called "shadowless" effect of **fluorescent tube lighting** be compared with that of **indirect lighting?** Do certain limitations of the latter also apply to the former? At a recent committee meeting I heard quite an eminent expert declare, without contradiction, that to sew material with cotton of the same tint was well-nigh impossible by indirect lighting, because the shadow of the thread was lost. Yet we have Mr. Owen declaring that by high intensity fluorescent lighting, also described as "shadowless," he can darn socks with ease, which he could not otherwise do. I suspect that the discrepancy is associated with the habitual use of that loose word

"shadowless" to describe conditions which, if explored with the **shadow-tester** advocated by Mr. Howard Long and Dr. Norden, might prove to be widely different.

The recent presidential address of Mr. Frank Parfett to the Society of Engineers dealt with several topics which are not only of great general interest but are of direct concern to those associated with illuminating engineering. One of these is the need for **a joint national building,** available to all **the leading scientific and technical institutions,** such as exists both in the United States and South Africa.

There have, I believe, been many efforts in this direction in the past, but they came to nothing, partly, no doubt, because the most eminent institutions here are already provided with stately and comfortable homes of their own and may well prefer their present splendid isolation.

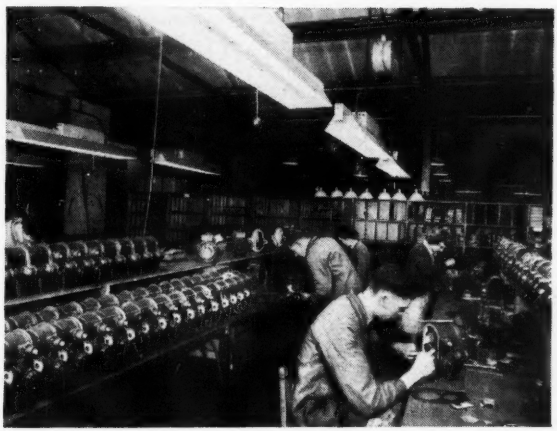
The idea of a joint home therefore appeals most strongly to the lesser bodies with smaller resources. The idea loses something of its glamour if the leaders remain outside. Yet, even so, there are many bodies—the Illuminating Engineering Society is one—which have grown greatly in membership and status during recent years. The position is therefore somewhat different from what it was in the past. It may be that the effort to which Mr. Parfett alludes may now prove more successful. I hope that it may do so.

Mr. Parfett also declared that in the provision for **technical training and research** we are not only far behind the United States but also behind the U.S.S.R. Certainly it must be admitted that our present facilities for training in illuminating engineering are limited and incompletely organised. The I.E.S. is making efforts to tackle this far from easy problem, and I hope they will ultimately succeed in establishing not only a basis of training but an adequate "hallmark" for those who have undergone it.

But here a word of caution is necessary. Mr. Parfett foresees the time when the use of **the word "engineer" may be restricted** to those who have taken the qualifying examinations of the leading institutions. Certainly the scrutiny applied to titles and distinctions may become more rigorous. Whilst, therefore, in regard to training facilities we may safely go full steam ahead we may have to be a bit careful in bestowing professional titles.

Fluorescent Lighting to Facilitate Production

The accompanying picture illustrates the advantages of fluorescent lighting in facilitating special production processes. In the background tungsten lamps in dispersive reflectors are used to illuminate comparatively coarse work. In the foreground Osira fluorescent tubes serve for assembly and test work involving fairly fine intolerances. The low surface brightness and soft shadows formed by light are here of great value. It will be noted that tubes mounted in line behind the assembly benches provide good illumination on *both* horizontal and vertical planes.



An Emergency Signalling Mirror

An account of a useful contribution of war equipment is to be found in *Illuminating Engineering*, April, 1944, p. 253),—the emergency signalling mirror described by Mr. Wentworth M. Botter.

In the present war, involving far-flung travel by land, sea and air, men are often found adrift at sea or lost amidst isolated deserts or mountains. Early rescue is often vital if lives are to be saved and attention-compelling visual aids are no less needed by day than are lighted beacons by night.

A flash of sunlight from a reflecting surface affords a ready means of attracting potential rescuers, but two things are necessary, a mirror with a surface that stays bright and cannot be deformed and a method of making sure that the beam of reflected light is precisely aimed at the target—perhaps a very distant one.

The device consists of a 4 in. x 5 in. pocket-sized plate of tempered polished plate glass with smooth edges, rounded corners, and a corner hole by which it can be suspended round the neck. The rear surface carries a thin film of vapourised aluminium of high reflectivity. This serves both as the front reflector directing the beam and as a "sighting reflector" at the back.

In the centre of the mirror film there is an aperture in the form of a cross. The observer holds the mirror a few inches from his eye and faces it about half-way between the directions of the sun and the rescuer. The sun shining through the cross should be intercepted by part of the person, for instance the hand, on which a bright image of the cross is formed by the sun. The mirror is then tilted until the image of this bright cross appears in the back reflecting area. The final step is to sight the rescuer through the centre of the cross and at the same time to bring the reflected image of the cross over the aperture.

This process ensures that the angles of incidence of (a) sunlight striking the front surface and (b) the rays coming from the intercepted bright cross-shaped spot and reflected to the eye by the round rear mirror are equal. Under these circumstances the line of sight on the rescuer and the line of the reflected beam from the sun become identical, and an accurate aim is secured. The user may sometimes find it difficult to hold the narrow beam steadily on the target, but fortunately rapid flashes from a wavering hand more readily arrest attention, especially as concerns peripheral vision.

Gas in Buildings

A statement issued by the Institution of Gas Engineers draws attention to work being done in connection with Codes of Practice, now being prepared under the aegis of the Ministry of Works and to be finally issued by the British Standards Institution.

The Gas Installations Committee has been asked by the Ministry to review existing information and practice concerning installations in certain buildings, to review proposals for improved gas-operated appliances for various purposes, to make recommendations for practice in post-war buildings, and to advise in regard to the use of "bottled" gas in buildings. The Report of the Gas Installations Committee has just been published by H.M. Stationery Office (price 6d.).

The Council of the Institution, which arranged in 1942 for the setting up of Gas Engineering Advisory Boards throughout the country, reports that there is widespread appreciation of the work of these Boards, and that considerable success has attended their efforts.